

City of Reading
Public Works – Utilities Division
Excerpt from WWTP Design RFP November, 2007

Existing Wastewater Treatment Facilities and History

The City of Reading owns and operates a regional wastewater treatment plant (WWTP) on Fritz Island which is designed to treat 28.5 million gallons per day (MGD) originating from fourteen municipalities. Fritz Island is an island formed between the Mifflin Arm of the Schuylkill River, the Schuylkill River, and the Angelica Creek. The original WWTP was constructed in the late 1800's on the opposite side of the Angelica Creek from the current WWTP's Fritz Island location. In the late 1800's, the area selected for the WWTP was more rural than the urban area of the City. As such, the City constructed the 6th and Canal Street pumping station in that same time frame to convey the flow across the Schuylkill River from the urban center of the City to the more rural area where the treatment was to occur.

In 1929, the City moved some portions of the treatment plant and constructed a larger facility on the current Fritz Island site. During the 1929 construction, a pipe was laid to convey the original WWTP's primary clarifier effluent to the current location. To do so, this line crossed the Angelica Creek to transport the partially treated wastewater to the four newly constructed square fixed nozzle sprinkling filter beds.

With the growth in the City that occurred leading into the 1950's, the City evaluated their needs and determined the need to sewer additional areas which would require the construction of two additional pumping stations. The 19th Ward pump station was constructed to convey flow from a portion of the City near the Spring Township and Bern Township borders. This flow is conveyed via force main and crosses the Schuylkill River in the northwest section of the City and continues by gravity into the 6th and Canal Street pump station. The 18th Ward pump station was constructed in order to convey the wastewater from a section of the City in close proximity to the WWTP but at a lower elevation. At the same time, the City re-evaluated the primary treatment occurring at the original WWTP and the secondary treatment occurring at the Fritz Island WWTP. This resulted in all wastewater treatment processes designed at the current Fritz Island location.

The 1959 construction included primary clarification, two rock media primary trickling filters, the reuse of an original clarifier and construction of one new clarifier for intermediate clarification, the construction of a pump station to convey the flow from the intermediate clarifiers to the two newly constructed secondary rock media trickling filters, three final clarifiers, and a chlorine contact channel prior to discharge of the treated effluent to the Schuylkill River. For the solids handling, this construction included two elutriation (gravity thickener) tanks and two primary and one secondary digesters. All solids removal from the liquid process occurred in the primary clarifiers. The solids removed in the intermediate clarifier and final clarifiers were conveyed back

to the head of the plant to be removed through primary clarification. The plant as constructed in 1959 was designed to treat 15 MGD. Of note, in this general time frame if not before, the 6th and Canal Street pump station included mechanical screening to remove large solids, as well as, a grit removal system in order to protect the pumps conveying the wastewater. These same processes for the flows received from the 18th Ward pump station, were built into the grit chamber facility adjacent to the original WWTP site. For this reason, the effective treatment of the wastewater actually begins off site from the present WWTP.

As growth continued within the City limits and in the suburban area surrounding the City, outlying municipalities expressed their desires to have wastewater treatment capacity at the City of Reading facility. Intermunicipal agreements with many municipalities were developed in the 1950's in order to adequately treat the wastewater from their residents and this capacity was included in the design for Reading's Fritz Island WWTP. The continued growth of the City and surrounding suburban area began to create problems at the WWTP as evidenced by the then Pennsylvania Department of Environmental Resources (PA DER) actions. Determinations were made as to the volume and strength of flow projected from each of the municipalities and from within the City limits. These projections became the plant basis of design for an upgrade which had construction beginning in approximately 1986 and completed in 1988. This construction continued to have the one tank from 1929 and the tanks and trickling filters from 1959 remain in service. The plant's 15 MGD design capacity was increased to 28.5 MGD with the addition of one primary clarifier and one plastic media trickling filter which could be used as either a primary or secondary trickling filter. Intermediate clarification was increased by converting one of the original final clarifiers to an intermediate clarifier and constructing an additional intermediate clarifier. From the secondary trickling filters which remained as is, the flow was pumped to three new tertiary clarifiers followed by an innovative fixed film contact aeration system designed for ammonia nitrogen removal. One additional final clarifier was constructed. The chlorine contact tank was also modified to provide for better disinfection prior to discharge to the Schuylkill River. With regard to the solids handling, the original secondary digester was converted to become a primary digester and two new secondary digesters were constructed. During construction of one of these digesters, it was discovered that this was being constructed over an abandoned mine shaft. Following the completion of the construction, the connection prohibition was then lifted as the City had increased the treatment capacity of the WWTP.

With the continued growth in the area surrounding the treatment plant, odor complaints began to surface in this area. Additionally, as growth continued in outlying areas that were conveyed to the WWTP via pumping stations, PA DER issued the 1994 prohibition for the areas tributary to the 18th Ward pump station and the 6th and Canal Street pump station. This prohibition limited the number of connections by the municipalities on a monthly basis while the City conducted a plan of study and remedial action was taken. The prohibition of 1994 focused mainly on the collection system problems. In the same general time frame, the City began experiencing ammonia nitrogen effluent discharge violations. In 1997, a consent order and agreement (COA) was entered into with the

Pennsylvania Department of Environmental Protection (PA DEP). Also in 1997, the City entered into a COA with the United States Environmental Protection Agency (US EPA) regarding the industrial waste pretreatment program which had begun in the mid 1980's. The City of Reading performed a facility audit in varying degrees of the plant and collection system in their entirety. The City's response to the odor complaints and ammonia nitrogen violations was the construction of the expanded solids handling facilities and the covering and scrubbing of air from particular treatment units. This construction was designed during the late 1990's, and construction commenced in 1999 with substantial completion for most units by 2001. In this construction, the two existing belt filter presses were increased by an additional two belt filter presses, the elutriation tanks were removed from service as gravity thickeners and mechanical gravity belt thickeners were purchased and installed. One elutriation tank was abandoned entirely with the solids handling facility being constructed in its footprint. The remaining elutriation tank was converted to become a solids mix tank from which the gravity belt thickeners are fed.

The recommendations made from the collection system facilities audit and plan of study that followed the 1994 prohibition, resulted in upgrades to the 6th and Canal Street pump station, as well as, the replacement of the gravity line leading to the 18th Ward pump station, the construction of a new 18th Ward pump station sized appropriately to handle the flows being experienced, and the construction of a new force main leading from the 18th Ward pump station. Additionally, some improvements were required in the grit chamber to handle the additional flow, as well as, the headworks facilities at the treatment plant proper. This construction began in 2001 and was substantially completed in 2003.

Within the City's collection system, there are four pumping stations. As discussed, the 6th and Canal Street pump station is the oldest and conveys flow from seven of the fourteen municipalities contributing flow to the WWTP. This is approximately three-quarters of the flow received at the WWTP. The next largest pump station is the new 18th Ward pump station which serves six municipalities. The 19th Ward pump station services two contributing municipalities as well as the City with its flow ultimately being received at the 6th and Canal Street pump station. A very small pump station in the West Reading area conveys flow from several homes near the City limit. In addition to the lines coming from the grit chamber area and the 6th and Canal Street area, there are two smaller lines from an outlying municipality that enter the treatment plant on the plant grounds proper. One is a force main from the Flying Hills pump station in Cumru Township which includes some flows from a second municipality, and the other is a gravity line from a small portion of Cumru. These lines all converge in a primary distribution box at the same point where recycled flows are returned to the head of the plant.

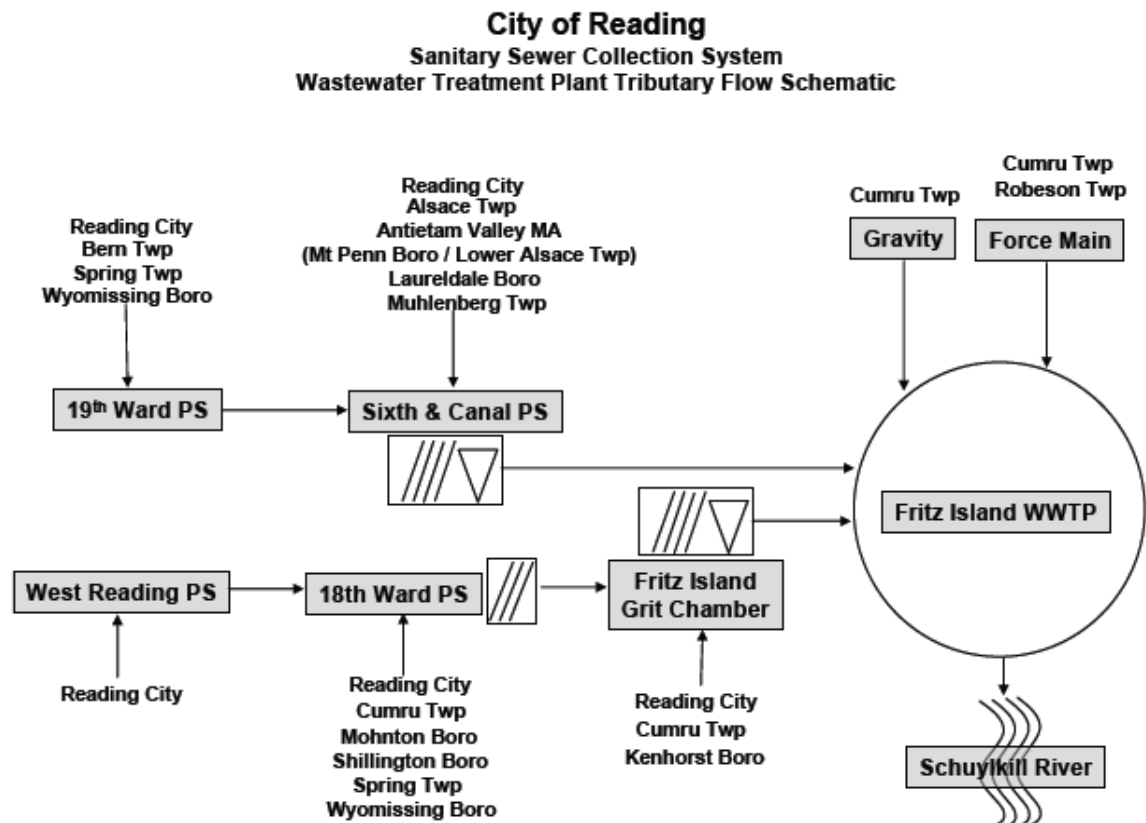
Existing WWTP Flow Schematics and Layout

The WWTP is a regional facility that currently receives flow from fourteen municipalities including the City of Reading, Antietam Valley Municipal Authority (includes Lower Alsace Township and Mt. Penn Borough), Alsace Township, Bern Township, Cumru

Township, Kenhorst Borough, Laureldale Borough, Mohnton Borough, Muhlenberg Township, Robeson Township, Shillington Borough, Spring Township, and Wyomissing Borough. The facility serves approximately 82,000 residents from the City of Reading with a combined tributary population of about 130,000 persons in the entire service area. The WWTP is located on Fritz Island, near the Cumru Township/Reading City boundary in Berks County, Pennsylvania and has a permitted hydraulic capacity of 28.5 MGD (Average Daily Flow) and 42.75 MGD (Maximum Monthly Flow) with discharge to the Schuylkill River.

The wastewater treatment plant tributary flow diagram for how wastewater from the City and contributing municipalities enters the collection system and arrives at the WWTP is shown below in Figure 1.

Figure 1. Reading WWTP Tributary Flow Schematic



An aerial photograph of the existing WWTP in Figure 2 shows the current layout of the treatment units on Fritz Island to better help put the existing plant in perspective.

Figure 2. Reading Existing WWTP Aerial View



The WWTP operates under NPDES discharge permit # PA0026549 which expired May 1, 2006. The City has applied for an NPDES permit renewal which has yet to be received from the Pennsylvania Department of Environmental Protection (PADEP). The City's effluent discharge is via a submerged outfall into the Schuylkill River.

The existing WWTP's liquid and solids process flow schematics follow in Figures 3 and 4 respectively. Please note that the new facilities will be located at the present location on Fritz Island and current wastewater operations must be maintained to provide effective treatment until new units become operational. Reading has made and continues to make interim operational and maintenance improvements in order to meet the current permit limits with the existing facilities while evaluations were being conducted to determine the future course of action to ensure long-term permit compliance with anticipated future capacity and permit limits. It is critical to continue to maintain permit compliance during the design, permitting, and construction process. Construction phasing is paramount in the planning process in order to achieve this goal.

Figure 3. Reading WWTP Liquid Process Flow Schematic

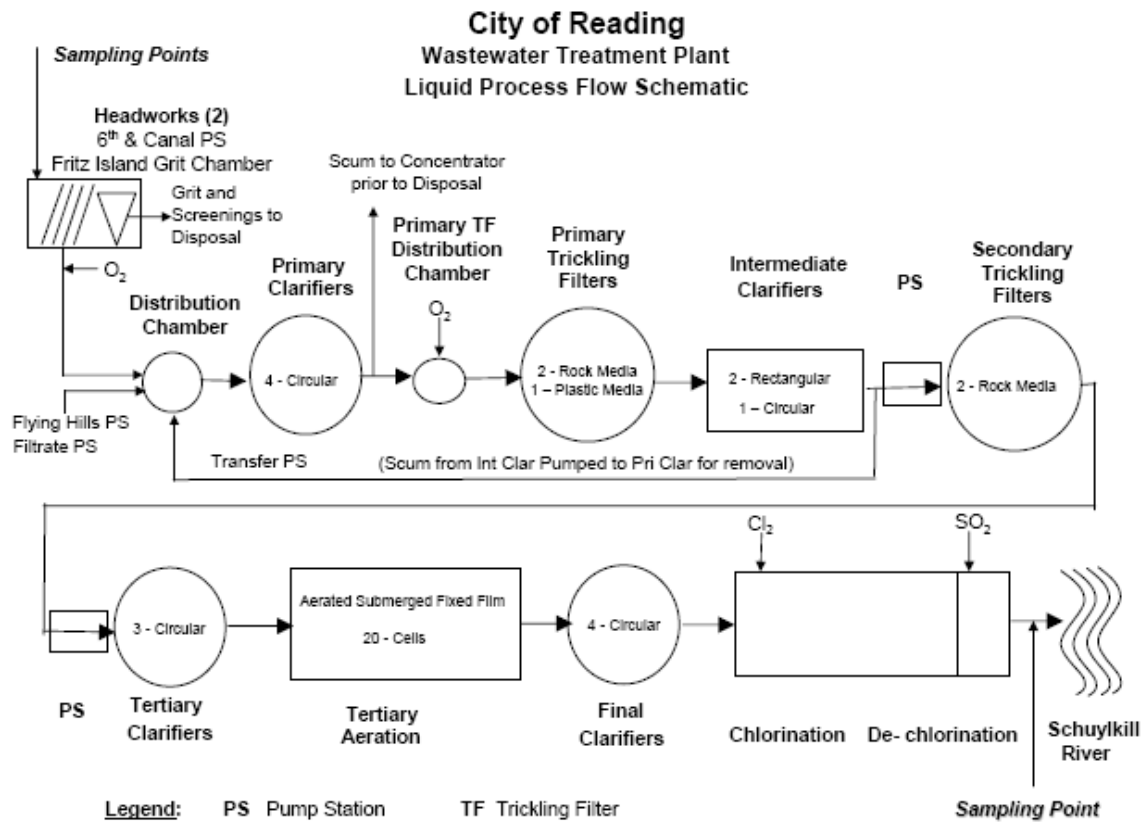
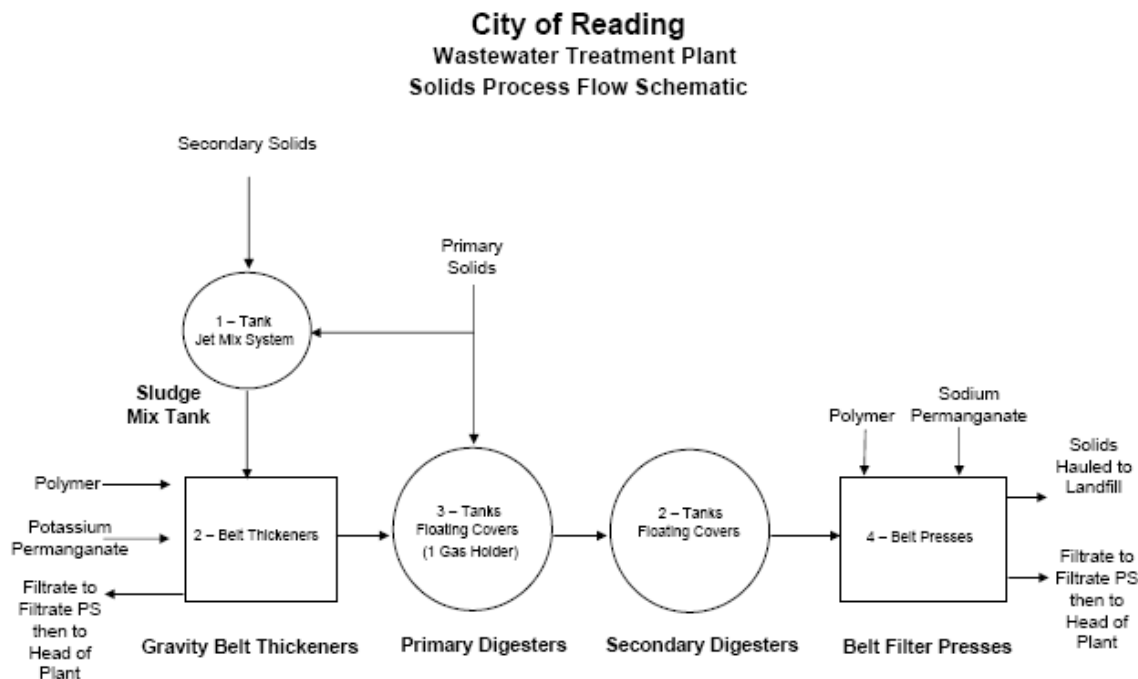


Figure 4. Reading WWTP Solids Process Flow Schematic



Consent Decree and Treatment Alternatives

In April, 2003, the City was requested to meet with the United States Department of Justice (USDoJ) as well as United States Environmental Protection Agency (USEPA), and PADEP to discuss Clean Water Act issues. This suit was settled and culminated in a Consent Decree which was executed in December, 2004 and signed by the judge on November 7, 2005 as the Entry Date. This Consent Decree details studies to be performed leading to a capital improvements plan and rehabilitation plan for the treatment plant and collection system respectively and the industrial pretreatment program. In addition, there are numerous interim measures that involve developing, implementing, and maintaining various management systems designed to improve plant operations and maintenance with the ultimate goal of permit compliance. Additional information regarding this suit is available for review at the following site and by following associated links:

<http://www.usdoj.gov/usao/pae/News/Pr/2004/dec/reading.html> *Link may not be valid*

As part of the Consent Decree, the City was required to evaluate the existing treatment facilities to determine their ability to meet current and projected capacity, loadings, and permit limits during all potential conditions. Black & Veatch was selected to perform this evaluation and determined that the existing facilities are able to meet current permit limits under many, but not all, existing conditions. The evaluation determined the

capacity for all major existing plant processes. Additionally, long-range planning and the regulatory climate were evaluated to determine potential future permit limits. As projected future limits were not available from the regulators, these were assumed in the report based upon the regulatory climate in the state and nation giving special consideration to the recent NPDES permit effluent changes evidenced in the Chesapeake Bay region of Pennsylvania. The City does not want to be faced with designing, constructing, and financing another WWTP upgrade to handle more stringent limits in the near future and has deliberately chosen to be more conservative in the assumptions used for the future effluent limits as compared to the current effluent limits. Future flow and loading projections were developed allowing for future population and industrial growth. Maximum monthly and annual average projections were developed for use in evaluating the treatment alternatives. This showed that the existing facilities were not able to meet the projected future capacity, loadings, and permit limits which necessitated the evaluation of potential liquid treatment alternatives. Screening of available technologies led to a detailed evaluation of three alternatives. These processes were evaluated for both economic and non-economic factors to determine the best available liquid treatment alternative. The selected liquid treatment alternative is activated sludge with biological nutrient removal.

Additionally, the existing biosolids handling facilities were evaluated from digestion to disposal for capacity to handle solids generated in conjunction with the selected liquid alternative, the ability to improve ultimate disposal options and reduce potential costs, and the ability to continually provide solids treatment during construction of WWTP upgrades. The regulatory environment was considered as well as equipment life cycle due to the capital costs involved. Following a screening of technology, four solids handling scenarios emerged for further analysis and evaluation for both economic and non-economic consideration. As a result of this detailed evaluation, the selected biosolids management alternative includes two-stage anaerobic digestion, mechanical thickening and dewatering, and indirect heat drying.

The Evaluation of Existing Plant Capacity and Treatment Alternatives reports were submitted to USDoJ, USEPA, and PADEP for review, comment, and approval. The selected alternatives were approved as required in the Consent Decree context by all three regulatory agencies involved. As such, the City of Reading's intention is to continue with the selected and approved liquid and solid treatment alternatives.

In preparing the Treatment Alternatives report, several assumptions were made relative to tributary population projections and future industrial growth as they were used to project the future flows and loadings for the WWTP. Annually, each contributing municipality reviews its future flows and loadings using a five-year planning period consistent with Chapter 94 reporting requirements. The City has asked each municipality and/or authority to review its projections to a better long-term estimate. Since then, the City has met with each of the contributing municipalities and requested that they look in more detail at the future projections paying attention to land use, comprehensive planning, and existing zoning. This information has yet to be received from each municipality but will be used to make final adjustments to the flows used for the final detailed design by the

selected firm.

Additional Considerations for WWTP Design

The Consent Decree required the evaluation of liquid and solid treatment alternatives but did not discuss the need to evaluate facilities that are common to all treatment alternatives. For example, influent headworks, clarification, disinfection, and personnel all are required to be present for an effective wastewater treatment facility. The WWTP receives the majority of its flow from the 6th and Canal Pump Station whose force main enters the facility at the primary clarifier distribution chamber as shown in the process flow schematic. Additionally, all of the forward flow through the liquid treatment process is pumped twice during the typical treatment. The City desires to reduce the current forward flow pumping and maximize gravity flow through the WWTP. The City also desires to have influent screening performed on-site and incorporated into the WWTP headworks. Black & Veatch has been working with the City to evaluate disinfection alternatives and compatibility with the existing influent and treatment alternatives. Based on the report completed, the City desires to further investigate the use of ultraviolet disinfection. The City intends to include the design and of these integral common facilities as discussed in the WWTP Design and subsequent construction.